REMARKS

Administrative Overview

Claims 56-67 and 69-75 were examined in the Office action of July 27, 2009, and are pending.

Applicants note with appreciation the withdrawal of the claim rejections under 35 U.S.C. 101 in light of Applicants' previous claim amendments.

Independent claims 56 and 70, and claims 57, 65-67, 69, and 71-75 dependent therefrom, stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over U.S. Publication No. 2002/0154132 (**Dumesny**) in view of "Seamless texture mapping of subdivision surfaces by model pelting and texture blending," SIGGRAPH 2000, New York, NY, pp. 471-478, ISBN: 1-58113-208-5 (**Piponi**).

Claims 58-64 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over **Dumesny** and **Piponi**, and further in view of U.S. Patent No. 6,707,458 (**Leather**).

Applicants maintain their position that the claim amendments previously made in response to the Office Action dated October 28, 2008, suffice to distinguish the claims from the cited prior art. In the present response, Applicants submit further arguments in support of this position.

Upon entry of this paper, claims 56-67 and 69-75 will still be pending.

Interview Summary

The undersigned thanks the Examiner for his time and courtesy during the interview that took place on January 25, 2010. The undersigned notes that the discussion focused on arguments presented herein. Accordingly, this paper is intended to constitute a proper recordation of the interview in accordance with MPEP § 713.04, and also to provide a full response to the Office Action mailed on July 27, 2009.

None of the cited art teaches representing an arbitrarily-shaped user-defined region of a surface of a virtual object using a NURBS patch, as recited in each of independent claims 56 and 70.

Applicants respectfully traverse the rejections of claims 56 and 70 and their dependent claims over **Dumesny** in view of **Piponi**.

Amended claims 56 and 70 recite, respectively, a step of and instructions for defining a "NURBS patch" over an arbitrarily-shaped, user-defined region, in the recited method and apparatus for wrapping a texture onto a surface of a three-dimensional virtual object. The prior art fails to teach the use of a NURBS patch in this manner. By contrast, both **Dumesny** and **Piponi** model the surface of a three-dimensional object with a polygon mesh for purposes of texture mapping.

The Examiner has found the use of a NURBS patch alone insufficient to distinguish the claimed invention from the prior art, in particular, in light of other geometric representations of surface regions of virtual three-dimensional objects that are listed in the specification. However, the Examiner has indicated in the telephone interview on January 25, 2010, that the recitation of a NURBS patch may be found to have patentable weight when tied to particular advantages of the use of a NURBS patch over other geometric representations, as recited in the method and apparatus of the instant claims. Applicants assert that such advantages of the recited technique exist, and that the claims of the instant application are patentably distinguished from the prior art, as will be explained in more detail below.

First, Applicants draw the Examiner's attention to the fact that, throughout the specification, NURBS patches are the predominant example used to illustrate the application of Applicants' texture mapping method and apparatus. *See, e.g.,* paragraphs [0020], [0031], [0035]-[0036], [0105]-[0106], [0108]-[0110], [0123]-[0127], and [0132]-[0133] of the application as published, as well as FIGS. 3A-3B, 5, 6, 7B, 9, 18A-18B, 19A-19B, 21A-21C, 23A-23C, 24A-24B, and 26A-26C, which illustrate methods and apparatus using NURBS patches.

Representing an arbitrarily-shaped, user-defined surface region of a three-dimensional object with a NURBS patch is advantageous in that it inherently provides more flexibility in modeling the three-dimensional surface. For example, the boundaries of a NURBS patch need not be straight line segments, but may have variable curvature. *See, e.g.,* paragraph [0022] of the specification, as well as FIGS. 3A-3B. Previous texture mapping methods had not used NURBS patches in this way, and were not able to achieve this advantage. For example, the boundary of a surface region represented by a polygonal mesh is necessarily piecewise linear, as illustrated in FIG. 1 of **Piponi**. Furthermore, the area of a NURBS patch may have variable curvature in three-dimensional space (*see, e.g.*, FIGS. 18A-18B of the specification), whereas a polygonal representation necessarily consists of planar segments. Thus, NURBS patches afford the user greater flexibility in defining the surface region to which a texture will be applied, and facilitate a more robust, smoother fit to the surface region that is being modeled. Moreover, where the surface of the virtual object is analytically definable, a NURBS patch can even represent the surface exactly. *See, e.g.,* paragraph [0110] of the specification. By contrast, a polygonal mesh will only approximate a curved surface, and the accuracy of the polygonal representation can only be increased by increasing the resolution of the polygonal mesh, thereby increasing the associated computational cost.

Advantages of the use of NURBS patches in the recited method and apparatus are described, for example, in paragraph [0105] of the specification, reproduced below:

> In order to define a surface patch over a user-defined region of the surface of a 3D voxel-based model, a curve loop enclosing the user-defined surface may be divided into four boundary curves, which are used to generate a 4-sided NURBS patch whose interior approximates the surface of the voxel-based model and whose outer edges exactly match the four boundary curves. A NURBS patch is useful because it *relates (u,v) parameter space to a Cartesian space*, because it can be tessellated to any desired resolution, and because

> it *provides surface normal vectors at any point of the patch.* (Emphasis added.)

NURBS patches map the coordinates (x,y,z) of points on the surface of a three-dimensional object to surface coordinates (u,v) – they parameterize the surface. (For a description of fitting a NURBS patch to a user-defined surface region, *see, e.g.,* paragraphs [0105]-[0110] of the specification.) By contrast, polygonal meshes, such as the subdivision surface described in **Piponi**, do not provide such a natural parameterization. *See, e.g.,* **Piponi**, Abstract and third full paragraph of Introduction. Rather, as described in **Piponi**, "[a]ssigning texture coordinates to a subdivision surface consists of two parts – assigning values to control vertices on the zeroth refinement of the mesh and a technique for interpolating these values over the surface." NURBS patches do not require such interpolation between mesh points.

Furthermore, in certain embodiments, Applicants' disclosed texture mapping method involves the use of a second, planar (NURBS) patch that relates the parameters (u,v) of the first, non-planar NURBS patch to the two-dimensional coordinates (s,t) of the texture. *See, e.g.,* paragraph [0030] of the specification. The first and second patch together facilitate mapping the two-dimensional texture coordinates to the three-dimensional coordinates of the surface of the three-dimensional virtual object. Thus, Applicants' method does not require planar projection (or other standard projection) of the texture onto the surface. In **Piponi**, however, the texture is mapped onto the polygonal model by piece-wise planar projection. *See, e.g.,* **Piponi**, p. 474, first full paragraph.

Moreover, the use of NURBS patches is also advantageous in connection with Applicants' graphical user interface element ("widget") for adjusting the texture, as described in the patent application ("[a NURBS patch] provides surface normal vectors at any point of the patch", paragraph [0105]). An advantageous feature of the user interface widget is that one axis of the widget is normal to the surface of the three-dimensional virtual object. *See, e.g.* paragraphs [0139]-[0144] and FIGS. 18A-18B and 19A-19B. As pointed out in the instant application, surface normal vectors exist at any point of a NURBS patch that represents a user-defined surface region. In contrast, surface normal vectors are undefined on the edges of a polygonal mesh approximating the surface. This problem which is associated with polygonal meshes is more pronounced the finer the resolution of the mesh – and, keep in mind, such finer resolution becomes necessary for enabling accurate texture mapping for arbitrarily-shaped, user-defined regions.

In light of the foregoing, Applicants submit that the use of a NURBS patch as recited in the instant claims patentably distinguishes the claimed invention from **Dumesny** and **Piponi**, both of which are limited to polygonal models of surfaces of three-dimensional objects. Further, **Leather**, which was cited by the Examiner with regard to various dependent claims, does not cure this deficiency, as Leather does not teach or suggest the use of NURBS patches either.

Therefore, none of **Dumesny**, **Piponi**, and **Leather**, nor any combination thereof, discloses or suggests a method or system of selecting and texture-mapping user-defined, arbitrarily-shaped surface regions using NURBS patches. Thus, these references do not disclose all limitations of claims 56 and 70. Applicants request the rejections of these claims be reconsidered and withdrawn at least on this basis, and that claims 56, 70, and all their dependent

claims be allowed in due course. Applicants reserve the right to present further arguments regarding the patentability of the dependent claims, should this become necessary.

CONCLUSION

Applicants contend the claims are in condition for allowance. Applicants respectfully request reconsideration and withdrawal of all rejections, and allowance of claims 56-67 and 69-75 in due course. The Examiner is hereby cordially invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

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